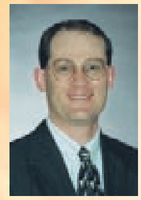

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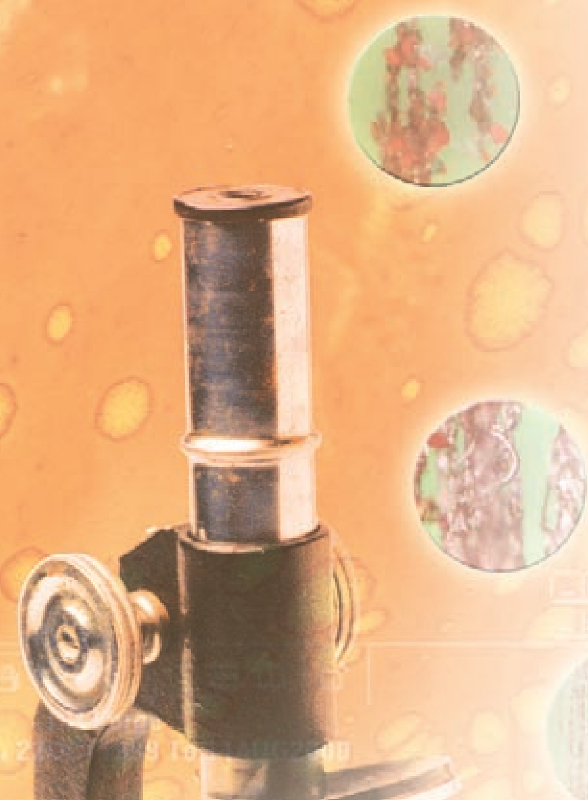
Oil Is Oil – Isn't It?



"What are lubrication best practices? To put it simply, it means selecting the correct lubricant, and then keeping it clean, dry, and cool."

Have you ever really thought about the lubricant you put in your machinery? In your car? Have you given much thought to the time and resources expended to:

- Recover and refine crude oil
- Process lubricating oil basestocks
- Develop and produce additives
- Blend additives with base oils to produce a finished product
- Continually improve lubricant performance through research and development into new and improved processes and additive technologies
- Meet increasingly more stringent safety and environmental requirements?

Perhaps you've heard someone say, "Oil is oil. As long as it's slick, it's OK." Is this the general attitude you take toward your lubrication program? Do you take appropriate measures to make sure the **correct** lubricant is used in each application? Do you take care to make sure your lubricants are kept **clean**, **dry**, and **cool**? Is prompt action taken when there are indications that your lubricant has been contaminated or degraded in any way? Are different brands or types of lubricants mixed together based on what is most readily available or on the lowest cost? Do you know that your lubricant can tell you about the health of your machines?

These are all very important questions to address. The aim of this article is to give you some general background information to consider when evaluating or developing your lubrication program. In the paragraphs that follow, we provide a general overview of the types of oils, process methods, and additive technologies employed to produce formulated lubricants. However, a detailed, chemical view of these topics is beyond the scope of this article.

Base Oils

Most lubricant base oils can be placed into three general categories: **mineral**, **synthetic**, or **vegetable**. Mineral and synthetic base oils are most common to the hydrocarbon processing and power generation industries. Vegetable base oils are used in applications where food contact and environmental impact are a consideration and will not be discussed here.

Mineral base oils can be further classified as **paraffinic** or **napthenic**. Each type has its relative advantages and disadvantages. In general, paraffinic oils will have a more stable viscosity response to changing temperatures (high viscosity index, VI). Paraffinic oils also have excellent oxidation stability and are relatively non-reactive. By contrast, napthenic oils perform better at low temperatures (low pour point) and have better solvency (low aniline point). Most mineral oils used in industry are paraffinic. A formulated lubricant may be a blend of paraffinics and napthenics to achieve the desired balance of properties in the final product.

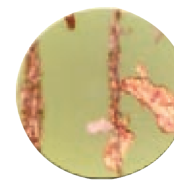
Synthetic base oils comprise a wide variety of fluids that have a broad range of applications, advantages, disadvantages, and costs. Synthetic lubricants must be carefully selected and consist of the following types:

- Polyalphaolefins (PAO)
- Dibasic Acid Esters (Diester)
- Polyol Esters (POE)
- Polyalkylene Glycols (PAG)
- Phosphate Esters
- Silicones
- Alkyl Benzenes
- Polybutenes

Some of these lubricants may be part of larger categories and others can be broken down into further subcategories. Those listed are the most commonly encountered synthetics.

A variety of processes are used in the manufacture of mineral-based lubricating base oils. These may be employed individually or in combination, and there may be variations within each basic type according to the desired goal. The basic processes include:

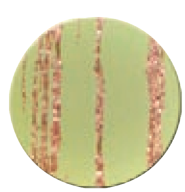
- Vacuum distillation
- Deasphalting
- Extraction
- Dewaxing
- Finishing
- Hydrotreating
- Hydrocracking



"Additives can be used to maximize the base oil's good properties and minimize its undesirable properties."

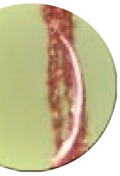
Additives

While lubricant base oils have inherently good properties, they may need to be enhanced to sufficiently meet the challenges of the application. Additionally, the base oil may have some undesirable properties that must be suppressed. Additives can be used to maximize the base oil's good properties and minimize its undesirable properties.



A multitude of chemical compounds are used as additives and they can typically be classified as:

- Antioxidants (Oxidation inhibitors)
  - Promote long service and storage life
- Antiwear Additives
  - Reduce friction and excessive wear when a full-fluid lubricating film is not present
- Antifoam Additives (Defoamants)
  - Break up large surface bubbles
  - Reduce the number of small air bubbles entrained in the oil



- Extreme Pressure (EP) Additives
  - Prevent seizure of sliding metal surfaces under extreme pressure (and temperature) conditions
- Pour Point Depressants
  - Allow lubricant to flow at colder temperatures
- Corrosion Inhibitors
  - Protect metal surfaces against chemical attack by water or other contaminants
- Rust Inhibitors
  - Protect metal surfaces specifically against rusting
- Viscosity Index (VI) Improvers
  - Reduce the lubricant's tendency to change viscosity with changing temperature
- Demulsifiers
  - Promote separation of oil from water
- Tackiness Agents
  - Improve adhesive characteristics of the lubricant in applications where lubricated components may tend to lose oil from their surfaces due to their orientation and the effects of gravity or due to rotating speed and centrifugal effects
- Detergents
  - Control deposit formation
- Dispersants
  - Create a colloidal suspension of particles to prevent formation of sludge, varnish, and deposits
- Alkalinity Improvers
  - Neutralize acidic products of combustion

Additives can comprise anywhere from less than 1% to over 25% of the composition of a formulated lubricant. A typical turbine oil may have only 1% additive while automotive engine oil may have around 25% additive. In general, lubricants for internal combustion applications will have higher additive content than those for industrial applications. These additives are expensive and can contribute to much of the final cost of a lubricant. Additionally, while additives are used to enhance the performance of a lubricant, they can also impart undesirable side effects if used in the wrong concentration or in conjunction with other additives. It is important to note that additives will have varying miscibility in different base oils, and proper procedures must be used to insure that they can be completely dissolved into the base oil and not separate out.

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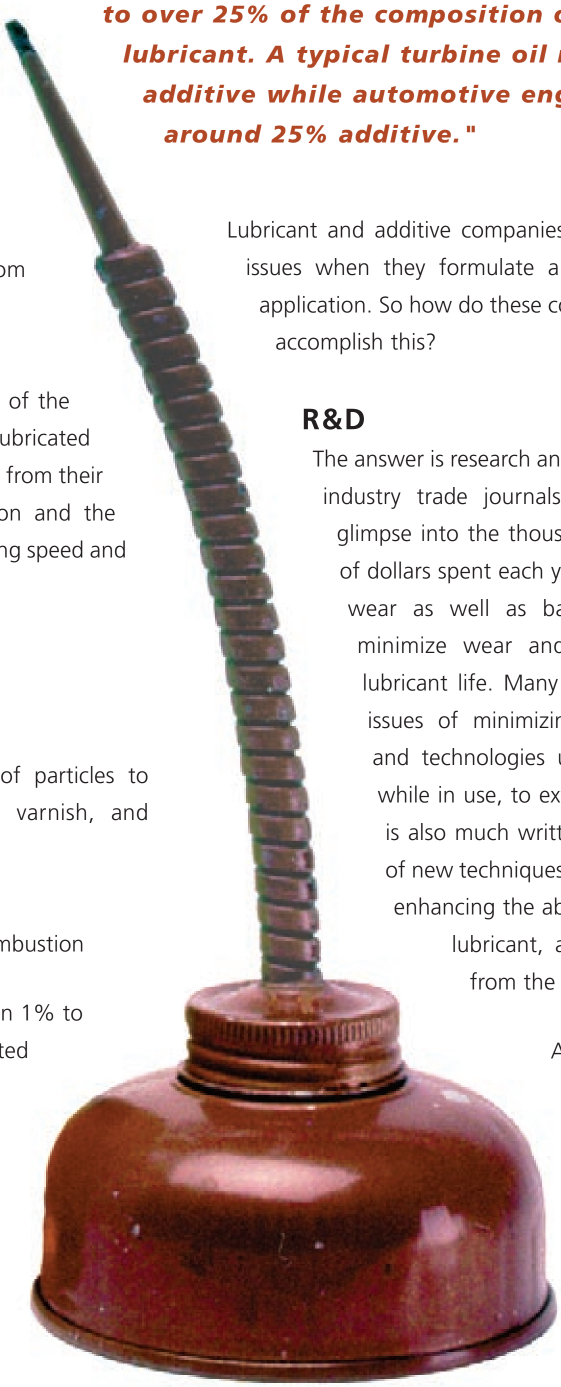

Lubricant and additive companies must look at all of these issues when they formulate a lubricant for a particular application. So how do these companies figure out how to accomplish this?

R&D

The answer is research and development. A review of industry trade journals quickly provides a brief glimpse into the thousands of hours and millions of dollars spent each year researching friction and wear as well as base oils and additives to minimize wear and maximize machine and lubricant life. Many articles also deal with the issues of minimizing contaminant ingression and technologies used to reclaim lubricants, while in use, to extend their useful life. There is also much written about the development of new techniques for lubrication analysis and enhancing the ability to determine machine, lubricant, and contaminant condition from the oil.

As an example, *Lubrication Engineering*, a scientific journal devoted to the study of tribology and lubrication, includes

articles in each issue regarding some aspect of lubrication and wear. Some of the articles discuss basic research and may not have plant application for years, while others may be immediately applicable to today's plant personnel. Often, the most interesting aspect of each issue may not be a specific article but an overall view of the attention devoted to this subject from universities, lubricant companies, and additive companies worldwide.

"Do you know that your lubricant can tell you about the health of your machines?"

Condition Monitoring Through Oil Analysis

Oil analysis can be a very effective tool in a condition monitoring program. Numerous tests and instruments have been developed (and continue to be developed) to help monitor and diagnose machinery lubrication problems. However, the industry-accepted term **oil analysis** can sometimes be misleading. It can imply that the primary area of interest is the condition of the lubricant, when in reality the primary goal is to monitor the **machine condition**. The most immediate and urgent question that must be answered is: "Can this machine continue to be operated safely and effectively?" The specific focus would be to look for the presence and trending of any wear metals.

The second focus should be the **lubricant condition**. "Is the lubricant in good condition and can it be expected to continue to protect the machine in the foreseeable future?" The focus would be to look at evidence of viscosity change, an increase in oxidation, and signs that additives may be depleting. The third focus should be the **contaminant condition**. "Is the lubricant clean and dry?" Emphasis should be placed on particle counts, water content, and contaminant metals.

In this discussion we have separated oil analysis into three condition monitoring classes. In reality, all three are interrelated and must be considered as a whole. For example, an increase in viscosity could be an indication that a lubricant is oxidizing. However, if there is no indication of an increasing oxidation trend either by acid number (AN) values or Fourier Transform-Infrared (FT-IR) analysis, oxidation could be an incorrect conclusion. Investigation, in conjunction with on-site personnel, might reveal that a higher viscosity oil was accidentally added to the system, thus resulting in the higher readings.

In terms of implementing a **proactive lubrication program**, these three conditions should be prioritized in reverse order. Assuming that an appropriate lubricant has been selected, utilizing **lubrication best practices** to prevent and remove contaminants is the most important action to take for maximizing machine and lubricant life. Managing contaminant condition below alarm levels, before machine or lubricant degradation can begin, provides the best value for the maintenance dollar. Even under the best of circumstances, a lubricant will eventually degrade. By monitoring its condition, actions can be implemented to refresh or replace the lubricant before serious machine damage begins. If damage is initiated due to operating, contaminant, or lubricant problems, the machine condition can be monitored and the machine may be shut down immediately to minimize damage, or actions may be implemented to extend machine runtime to a suitable shutdown opportunity, depending on the situation.

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Consequences

What are the consequences of following, or not following, lubrication best practices? Following lubrication best practices will maximize machine availability, machine life, and lubricant life. Machine downtime is minimized, as well as unit repair costs and lubricant purchase and disposal costs. Implementing such an approach enhances the value of the oil analysis by improving the signal-to-noise ratio of the information captured in the oil. In some cases, such as oil sampling, failure to use

best practices can result in missing critical information or getting a "false positive" that may not be indicative of actual machine condition.

On a larger scale, lubrication best practices can contribute to preserving our natural resources, improving safety and health, and minimizing environmental impact.

What are lubrication best practices? To put it simply, it means selecting the **correct** lubricant, and then keeping it **clean**, **dry**, and **cool**. In reality, it involves numerous technologies and practices to ensure those ideals are met and will vary depending on the application and the specific issues involved.

To achieve best results, each component must be properly specified. If not, the complete system will not perform as desired. No lubricant can compensate for a poorly designed bearing, and no bearing can compensate for an improperly selected or poorly maintained lubricant.

Are you taking care of your lubricants? Do you pay as much attention to your lubrication practices as you do to your other maintenance practices? Are you listening to what your lubricant is telling you about the condition of your machine? Is your machine availability where you want it to be? Are your unit repair costs where you want them to be?

"The second focus should be the* lubricant condition.*"

"The third focus should be the* contaminant condition.*"

If you can say yes to these questions, you have an effective program. If not, you may want to look at your lubrication program and determine what improvements may be necessary. If the internal expertise is not available to perform this or other lubrication-related tasks, Bently Nevada's Lubrication Services organization stands ready to assist you.

Conclusion

So now we come back to the original question and the title of this article: "Oil Is Oil – Isn't It?" Just as there are many types of machines and many types of bearings, so too are there many types of lubricants. Each machine, each bearing, and each lubricant is specifically designed for its individual application. Just as a natural gas engine shouldn't be used where a gas turbine is called for, a natural gas engine oil should not be used in a gas turbine.

We hope this article has provided a better understanding of how lubricants are designed and how the information that can be obtained from oil analysis will give you a better appreciation for all that your lubricants do for your machinery. If you take care of your lubricants and listen to what they tell you, you can expect long and healthy machine life. ORBIT

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